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Soil Fertility Matters

A Newsletter on Soil Fertility and Fallow Management in the Upland Tropics

This third issue of *Soil Fertility Matters* is produced under the project titled the *Interim Information Support for the Southeast Asian Regional Network on Soil Fertility and Improved Fallow Management*, based at the University of the Philippines Los Banos-Foundation, Inc. (UPLB-FI) and funded by the International Fund for Agricultural Development (IFAD) through the World Agroforestry Centre (ICRAF).

Inside this issue...

Local Knowledge

represents the body of knowledge that develops, becomes shared, and is used by a particular social collectivity (e.g., farming community, ethnic group) in the pursuit of ceratin goals and interests (Campilan and Prain, 2003).

Managing Soil Fertility in Northern Philippines through Indigenous Strategies

D.B. Magcale-Macandog and L.J.M. Ocampo

Even before the oldest farming technology was introduced, the local people have their own ways of fertilizing the soil. Yet, the introduction of the newest farming techniques has never replaced their indigenous ways.

An example of rice terraces in Northern Philippines

This circumstance holds true for the two indigenous communities found in the Cordillera Mountains in Northern Philippines with regards to their soil fertility management. Barangay Bayyo in Bontoc, Mt. Province and Barangay Ducligan in Bucloc, Abra never bother to acquire inorganic fertilizers to nurture soil. Instead, the local people stick to the indigenous ways — fallowing the land or using plant species as organic fertilizers. Both barangays are very fortunate to have discovered particular species to manage soil fertility in their cropping fields.

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How to Manage Acidic Tropical Uplands

D.B. Magcale-Macandog

Sixty to more than 90 % of Southeast Asia (SEA) are upland areas. Before, these areas were sites of undisturbed natural forests. However, rapid population growth resulted in upland migration. Upland migrants have now no choice but to cultivate the land for a living, thus, transforming natural forests to agricultural lands. This transformation has lead to

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Providing Knowledge Support to Upland Farmer Initiatives

E. Queblatin

Nang Editha is a female upland farmer belonging to the indigenous Subanen tribe in Lakewood, Zamboanga del Sur, Mindanao. For almost two years now her half –hectare hillside farm is effortlessly evolving into a series of terraces where she plants corn and a variety of crops. She is quite excited. This could mean less cultivation work and reduced soil erosion.

During land preparation two years ago, she left narrow strips of naturally occurring grasses on the contour untouched and unplowed. These strips now serve as barriers against soil erosion. The technique did not require imported planting material nor tremendous labor.

Nang Editha learned about this simple soil conservation and management technique from another indigenous upland community

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In the Highlands...

Once again it has been proven that Participatory Rural Appraisal (PRA) is a good methodology of information exchange among stakeholders and community members.

This year, two PRA activities were already conducted in two barangays of the two provinces of Cordillera Highlands, Philippines. One was held in Barangay Bayyo, Bontoc, Mt. Province on March 11-13, while another was conducted in Barangay Ducligan, Bucloc, Abra on May 12-14. Significant results were gathered during the activity. The *Lapat* System is one of them.

Lapat Systems among the Indigenous Swidden Farmers of Apayao

by: Ben Maata

adapted from "Shifting Cultivation: Towards Sustainabiliy and Resource Conservation[1]"

Lapat system: definition and history

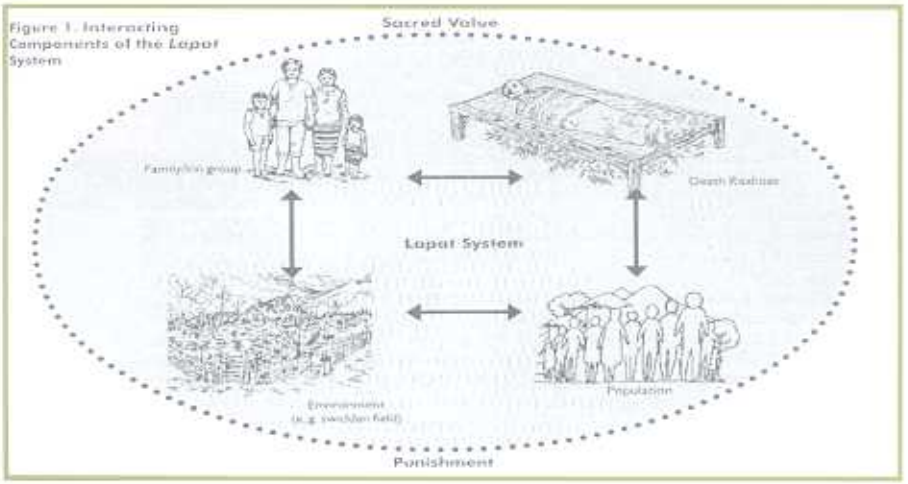
Lapat is a traditional practice of a bereaved Isnag (indigenous people of Apayao)family where material resources (e.g. a cultivated swidden field or fallowed field, a portion of the mountain, river, or a portion of the forest) are declared off-limits to people to show their respect and value for a dead family member. The *Lapat* is identified by a symbolic declaration that all persons outside the family member are barred from entering, using, or holding any of the material resource declared as prohibited or off-limit by the bereaved family. The family decides the duration of *Lapat*, which may be from 1 to 30 years. Under *Lapat*, the surroundings and ambiance is regarded as "sacred", thus exploitation of resources in the area is temporarily halted.

The most valuable function and output of the *Lapat* system in the Isnag communities is its tremendous contribution to resource conservation and socioeconomic upliftment of the family. There are various manifestations of these functions, for instance, they were able to rejuvenate the soil fertility of their 10-year old home garden, harvest large trees for lumber and construction of their new house, harvest 1000 coconuts from only 20 trees and plant more in other cultivated areas. To a certain extent, sustainability of swidden fields in terms of land utilization is also experienced by the owners of Lapat. In the case of one of the key informants (KIs), she claimed that the family was able to regain the financial loss and even had more than what they expected after they re-opened the Lapat, 15 years later. This is because they were able to harvest trees, rattan, fruits, and coconuts, and even hunted wild boar and deer.

Insights to consider in sustainable shifting cultivation and resource conservation

- The attitude and respect manifested on the *Lapat* satisfies the bereaved family members and the community. From this, closer social ties, economic support, cultural and environmental "bond-strengthening" are created.
- *Lapat* system is a socio-cultural and environmental management practice that largely contributes to the behavioral change of the family towards other Isnags and other community.
- *Lapat* is a unique transformation that eventually contributes to the sustainability of agricultural practices—in this case, swidden cultivation practices and resource conservation.
- *Lapat* transforms the economic conditions of the family to a favorable level.
- *Lapat* system is similar to the beliefs and practices of some tribes in other parts of Asia.

Components of Lapat



Coffee...break!

Mr. P. Tinggomong, Provincial Action Officer of Abra, reports about the plan of the provincial government to promote Natural Resource Management System of the Tinggguians in Abra through the Lapat system. Part of the effort is the formal request of the provincial government to the Department of Environment and Natural Resources to legally accredit Lapat System, as declared in its Resolution No. 09-2002 dated February 4,2002

[1] A publication of IFAD, IDRC, CRDI, CIIFAD, ICRAF, and IIRR

Using Local Knowledge to Conserve the Diversity of Sweet Potato in the Philippines

adapted from "Agricultural Biodiversity Kit!"

Rootcrops and other non-cereal crops are often lumped under the category of "secondary crops". These are considered by some to be of low importance and consequently receive far less public and private sector investments in human, financial, and other resources.

Contrary to their level as secondary crops, rootcrops have been utilized in many parts of the world for multiple purposes in different agroecological and socioeconomic conditions. Particularly for sweetpotato, research has shown that it performs primary functions such as: consumption and nutrition, income and employment, and sustainability and social equity, within and among farming households in Asia.

In spite of the primary importance of secondary crops like sweetpotato, it has received extremely low level of attention from mainstream scientific research even with its large distribution and livelihood importance throughout Asia.

On the other hand, local knowledge on sweetpotato has evolved out of farmers' need to learn about the crop and its relevant scientific knowledge. Among resource-poor farming households in marginal agricultural environments, local knowledge is one of their few vital resources for sustaining agricultural livelihood. Empirical studies undertaken by the Users' Perspective With Agricultural Research and Development (UPWARD) Network and other research projects of the International Potato Center (CIP) revealed household's conservation and cultivation of the crop are often neglected by formal agricultural research institutions.

[1]A publication of CIP-UPWARD

Sweetpotato in the Philippines: Cultivar Diversity and Local Knowledge

In the Philippines, cultivar diversity is a key element of local sweetpotato production systems. The following serve as major impetus for local farming households to conserve sweetpotato diversity: local food consumption patterns and preferences, adaptability to local growing conditions, and traditional beliefs and practices.

Local knowledge on diversity of sweetpotato cultivars helps ensure that specific cultivars are available when and where farmers need them. Local knowledge is an essential resource for identifying, cultivating, utilizing and maintaining different cultivars for different livelihood purposes.

Local Knowledge as a Starting Point for Conservation of Sweetpotato Diversity

For research and development efforts to support agricultural biodiversity conservation, exploring local knowledge is a useful starting point in conservation efforts. Through the assessment of potential value and use of local knowledge, especially of neglected crops such as sweetpotato, research and development workers can build on a key resource in identifying and introducing appropriate conservation strategies.

Terminologies

Local people choose descriptive labels in referring to various aspects of their environment. For instance in the Philippines, they assign names to sweetpotato cultivars based on: distinguishing characteristic (e.g., *Amsitan* for bland taste), person who introduced the cultivar (e.g., *Bentong*), place from which it originated (e.g., *Kapangan*), or popular personality (e.g., *Imelda*).

However, cross-checking with standard scientific nomenclature is necessary because the use of local names is highly arbitrary and variable.

Concepts

Local people develop constructs to represent particular agricultural activities, outputs or preferences. One example is *nabukag*, a multi-dimensional trait associated with mealy taste that is popular among subsistence farming households in the Philippines. Generally, farmers articulate a wide range of sweetpotato attributes (i.e., morphological, gastronomic, physiological/ ecological, familiarity, and function or use) that no single cultivar can fully satisfy. As a consequence, farmers cultivate a mix of cultivars with complementary traits.

Beliefs and Values

Traditional beliefs and values influence agricultural decisions and actions. In southern Philippines, farming communities do not view incentives for conservation, only in terms of material benefits. Other valued incentives include the symbolic importance of the crop, opportunities for strengthening social networks, and the power and authority that is associated with leading conservation efforts.

Crop Management Practices

Intimate knowledge of crops and varieties is part and parcel of local agricultural knowledge systems. Local people learn and adopt different practices of maintaining a variety of cultivars for various uses. Subsistence farmers in the Philippines deliberately cultivate a mix of short-maturing cultivars (e.g., Manobo, harvestable after

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Coffee... break!

Bayyo people claim that sweet potato has been the basis of their survival since the beginning. Sweetpotato was their staple food during the Spanish era and the survival food during the Japanese occupation in World War II. At present, it is the 2nd staple food of the community.

Managing Soil Fertility...

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I. Indigenous Plant Species as Organic Fertilizers

a. Sunflower in "Payew" fields

In the highlands of Bayyo, Bontoc (1000 masl) *Tithonia diversiflora* or commonly known as "sunflower", grows abundantly. This species is well adapted to the cool environment (18 °C) in the area. It is the most significant plant species in Bayyo used for soil fertility management. The local people of Bayyo have an indigenous practice of incorporating sunflower cuttings in the payew (rice field) since long time ago.

Payew is known as the irrigated rice terraces varying from 100 to 250 m² in the area. These rice terraces were built long time ago by their ancestors and have been passed on from generation to generation within the family. It is characterized by paddy soil irrigated with water from the surrounding mountains. These paddy fields are primarily used for irrigated rice production. However, other crops such as sweet potato, cabbage, and green onion may also be grown in the area after harvesting the rice crop. It is cultivated continuously within the year.

Sunflower is the main organic fertilizer in "payew"

During land preparation, sunflower cuttings (leaves and branches) are incorporated in the mud in the payew fields by stepping on it (tapak-tapak). About four big bundles (approximately 1 foot in diameter) of sunflower cuttings are applied per farm. The sunflower cuttings are allowed to decompose in the mud during the rice growing season. In this process, nutrients from the decomposing sunflower cuttings are slowly released into the soil for rice crop uptake. Sunflower is the main organic fertilizer that farmers apply in the payew fields. Farmers observe that their rice crop productivity in payew fields is sustained through the years by sunflower cuttings application.

Indigenous farmers have observed that sunflower cuttings applied on the soil before planting rice rejuvenates soil fertility, thus, giving the plants vigorous growth, preventing rotting of sweet potato and loosening the soil. Hence, sunflower

Sunflower can be found anywhere within Bayyo

is providing the people a higher production of their crops. Sunflower grows abundantly in the area, thus it is readily available. Other fertilizers such as hog and chicken manure gave the same effect on the soil and crops, only they are rarely found in the area and still have to be bought. The community does not use inorganic fertilizers because based on their experiences, inorganic fertilizers harden the soil, thus sweet potato tubers often do not develop. In addition to that, urea (an inorganic fertilizer) induces foliar growth instead of tuber growth. Another reason is that, they do not have enough money to buy such inorganic fertilizers.

Sunflower is commonly applied before rice cultivation because farmers reckon it is the best for rice growth and rice plants really needs the sunflower fertilizer. It is not usually applied in the second crop (sweet potato), because they think it is not necessary for sweet potato crop since it makes use of the residual fertilizer of the preceding rice crop. In addition to that, sunflower plants are heavy and it would be more practical for just a single application.

Second crop is more labor intensive than the rice crop and farmers do not have time to apply sunflower for the second crop. Others, though, may opt to apply fertilizer such as sunflower and rice straw in sweet potato crops.

b. *Chromolaena odorata* in Ducligan rice paddies

In Barangay Ducligan, Bucloc, Abra, local people discover another organic fertilizer that is most accessible to the community. *Chromolaena odorata* is the most significant species in their soil fertility management, since it could be found almost everywhere in Ducligan due to its lower elevation (500 masl) and higher average temperature (28°C), which are very favorable for *Chromolaena* growth.

Ducligan is famous for its rice production. Rice is the principal crop grown in the rice paddies on which the people spend most of their time and attention all year round. Most farmers are engaged in traditional farming practices. Two crops of rice are grown in the rice paddies in a year. Farmers prefer to plant traditional rice varieties. The dry season rice crop is termed as 'ulitay' and the wet season rice crop is termed as "sawali".

Chromolaena odorata (wulawol, hagonoy) is the main source of fertilizer in the rice paddies at Ducligan. *Chromolaena odorata* cuttings are applied in the wet rice fields during the cultivation stage. The cuttings are allowed to decompose in the rice fields during the growing season of rice. Other sources of fertilizer are prunings of *Gliricidia sepium* and rice stover. Farmers observed that *C. odorata* is an effective fertilizer for their rice crop as evidence by the good growth of rice. The effectiveness of *C. odorata* as an organic fertilizer is attributed to its high nitrogen content and quick decomposition. On top of these, *C. odorata* grows abundantly in the area and farmers have plenty of supply of this 'free' organic fertilizer in the area.

Commercial fertilizers can damage the soil

Ducligan farmers try very hard not to incorporate commercial fertilizers in the soil. Commercial fertilizers, according to their experience, damage the soil by hardening it and making it acidic. Other reasons include the high cost of commercial fertilizer and the production of low quality products. Farmers observed shortening of storage life of rice grains harvested from rice plants fertilized with inorganic fertilizer.

Chromolaena odorata

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Managing Soil Fertility...

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The discovery of *C. odorata* and *T. diversiflora* as organic fertilizers again proves the resourcefulness, innovativeness and creativity of upland farmers. Through this, they are able to maximize the available and most accessible resources. They have not only found a cheaper way but also a better and more effective way of regaining soil fertility.

II. Application of Weeds as Mulch in the "Katualle" fields (in the case of Bayyo only)

Katualle is a rainfed upland terraced field under continuous annual cultivation. It is located at gentle slopes near the main road and houses and usually covers an area of 50 m^2. A field intermediate between the uma (swidden farm) and payew (rice pond terrace), katualle is close to the village and has less elaborate terracing than the payew. Unlike the swidden fields, katualle is established as a 'private property'.

Katualle is perennially cropped with sweet potato and other crops including corn,

peanut, squash, legumes, cabbage, pepper and onion. In the katualle, farmers apply any weeds removed from the farm and place them in between sweet potato crops as mulch and organic fertilizer. This is a means of controlling weed growth, too. Peanut is commonly grown in the katualle fields. Since soil in the katualle fields is sandy, growth of peanuts here is better than in uma which has heavy soil (clayey). After harvest, peanut crop residues are left on the soil as fertilizer for the next sweet potato crop. Sweet potato leaves, on the other hand, are left on the soil for the subsequent peanut crop. If farmers have available time, they also apply rice hull as additional fertilizer in the katualle fields.

III. Practice of Fallowing in "Uma" fields

Uma is known to be a rainfed upland swidden farm found in the sloping areas of the uplands. It is a field cleared in forest or bushland for shifting cultivation. In both Barangay Bayyo and Ducligan, uma is abandoned after a few years of cultivation to give its soil the time to rest and regain its nutrients. Length of fallowing ranges from 1 to 20 years.

The farming system in the 'uma' is a valuable component of the household as it is from the uma where they can get a variety of their food requirements including corn, vegetables and fruits.

The Area

Area of uma allotted to each household varies in each community. For the case of Bayyo, uma covers at least 500 m^2 of land. In Ducligan, however, size of uma ranges from 400 m^2 - 3000 m^2, depending on the availability of household labor that will till the land. When opening a field for possible uma, both communities choose sites that are not stony, sloping (but not very steep slopes), and planted with more than 20-year old trees. Very steep slope is prone to soil erosion when opened up for growing crops. In Ducligan, other criteria like presence of neighboring uma fields and coverage of Lapat system (forest conservation) are also considered.

Fallow Period

Uma is not continuously cropped like rice terraces and katualle fields. It is left for sometime for the soil to rest, and for rejuvenation of soil fertility. In Bayyo, uma is cultivated for 4 years before it is left to rest for about 1 to 20 years. The length of the fallow period varies from 1 to 4 years for

short fallow to as long as 20 years. Short fallow period is practiced by farmers who have few uma fields while long fallow period is practiced by farmers with greater number of uma fields. On the other hand, Ducligan farmers practice a relatively shorter fallow period after two cropping years. Fallowing in the area, which is locally termed as "ulkat", ranges only from 3 to 10 years.

Longer years of fallowing, lushness of existing vegetation, and abundance of decomposed leaf litter are the common

indicators of soil rejuvenation in both barangays. If there is plenty of vegetation to cut, there will be plenty of ash (a source of fertilizer) when the vegetation is burned after cutting and drying. Abundance of *C. odorata* and presence of earthworm droppings are also signs of high soil fertility level, according to the Ducligan farmers.

During the fallow period in Bayyo, sweet potato, which is the major crop cultivated in the area, is left to grow in the field for about 6 years before the land is opened again for cultivation. It serves as a cover crop to prevent soil erosion, although clayey and heavy soil in Bayyo is already soil erosion-resistant. Other species that commonly grow in the "uma' during the fallow period are runo grass, herbs, sunflower, grasses, pine trees and *Alnus* species. Pine trees grow in the area by natural regeneration through wind and birds, while *Alnus* was introduced by the Department of Environment and Natural Resources in the 1970's.

Alnus trees are believed to be capable of bringing back soil fertility faster and are good material for compost. Thus, they are also fertilizers in a way. Aside from those benefits, *Alnus* may also provide the people water and firewood. Their practice of fallow management justifies their rare application of fertilizers in "uma". There are also environmental and socio-economic benefits brought by fallowing. Environmental benefits include fresh air provided by trees (trees filter air pollution), beautiful scenery and more water. Socio-economic benefits include a biodiversity of products as wild fruits, moss, mountain tea, strawberry-like jam, and konna (medicinal herb); as well as raw materials for tigergrass broom, hardwood for handle of hammer and axe, and wood carving materials.

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Managing Soil Fertility...

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In the case of Ducligan, *C. odorata* is the prominent fallow species in the area. However, recent practice of farmers is to plant tree species (timber and fruit trees) in uma and to allow these trees to grow during fallow period. Intentional planting of these trees signifies that the a farmer plans to return to that particular uma field after the fallow period. Also, growing vegetation during the fallow period provides protective cover to the soil to prevent soil erosion. Soil in Ducligan is sandy and thus, prone to splash and surface erosion together with the run-off water.

Cultivation after Fallow

If the farmers think that the soil in uma has already regained its fertility enough to support another round of cultivation, land will be cleared by cutting and burning shrubs, herbs, and grasses. Fruit and timber trees are not cut and they are protected from fire by clearing the vegetation around the base of the tree before burning the field. The ashes from the burnt vegetation serve as fertilizer for the subsequent crop. Fertilizer is not applied intentionally when crops are planted in the uma fields. Farmers reckon that there is no need to do so since uma fields are relatively fertile and rich in nutrients resulting from fallowing. Nutrients can also come from the decomposition of plant litter from fallow species or from rice stover from the previous rice crop.

Mixed cropping is practiced in uma because farmers believe that its soil is fertile enough to support the growth of a variety of crops. Another reason is to maximize their use of the land, their time and effort allocated in the uma. Squash, beans, and corn are the common crops grown in the uma of Ducligan and Bayyo. In Bayyo, these crops together with millet and onion are just intercropped with sweet potato. After cropping, crop residues like corn and millet stover are burned and the ash is applied into the soil as fertilizer. Other farmers just lay out removed grasses and weeds on the soil surface as mulch.

In Ducligan, rice is also grown in the uma along with other vegetables such as *Cajanus cajan*, Abelmoschus esculentus (okra), *Colocasia esculentum* (gabi), *Corchorus olitorius* (saluyot), *Lagenaria leucantha* (upo), *Brassica chinesis* (pechay) , and *Zingiber* sp. ginger. Vegetable crops are usually planted along the periphery or boundary of the 'uma' farms while rice and corn are grown in mixture inside the 'uma' fields. This is their traditional way of planting the different crops in the uma.

Protective Measures

Traditionally, uma fields are considered communal areas in Ducligan. Anybody can open up uma areas under fallow. But, it is a different case in Bayyo, where each family is allotted their own uma. Lands under fallow in Bayyo are protected from cultivation or opening by other farmers in the community through the information drive campaign. During the barangay meetings, it is being announced that such lands are under fallow. Protection from fire is also enforced in Bayyo through a local ordinance of charging anyone a fine for lighting a fire that spread in the forest. Amount of fine is P100 for the 1st offense, P200 for the 2nd offense and P300 for the 3rd offense.

Now, who will tell that Philippines is far behind? These three strategies applied by the two upland barangays only prove that Filipinos do not easily rely to high technologies given an alternate cheaper, more accessible and more effective means. Isn't it that the ability to maximize the available resources and not the inexorable acquisition of new farming technologies is the indication of genuine innovativeness and resourcefulness?

Mixed Species Improved Fallows in Western Kenya

G. Cadish, et.al.

Declining or low maize yields on smallholder farms are common in Western Kenya particularly, since fertilizer prices have increased and the associated nutrient mining has decreased soil fertility. Natural fallows, which normally consist of a

combination of broad-leafed weeds and grasses, are used to restore soil fertility or to provide fodder for livestock but their effectiveness is low. Recent results have shown that improved fallow systems with fast-growing tree or shrub legume species like *Sesbania sesban* have a high potential to restore soil fertility and have become a central agroforestry technology for soil fertility management. These technologies have proven a high adoption potential with smallholding farmers in Western Kenya and Southern Africa. *Sesbania* has been the main focus for this technology partly due to its long traditional history with farmers and for its compatibility with crops, deep rooting, supply of additional wood products and large benefit to maize planted after the fallow. More recently other species such as *Crotalaria grahamiana* and *Tephrosia vogelii* have been tested with success in the region.

Benefits from improved leguminous fallows

Short duration improved fallows of 6-12 months increase the yield of subsequent maize crops by 1-3 t/ha in the first season compared with continuous maize cropping or natural weed fallows with subsequently lower benefits in year 2 and 3. The processes by which improved fallows achieve these benefits are by: a) accumulation of large amount of nitrogen rich biomass which is easily decomposable, hence releases nutrients rapidly into the soil, b) improved soil

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Mixed Species...

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organic matter and soil structure (noted by easier tillage operations), reduced erosion and improved weed suppression in dense fallows such as *Crotalaria grahamiana*, c) *Sesbania* fallows have a very deep root system, thereby effectively capture mineral nitrogen which has been leached below the crop rooting zone. This leads to a better recycling of nitrogen and reducing nutrient losses, d) leguminous fallows additionally enrich soil fertility through the process of biological nitrogen fixation (BNF). In this process the plant forms a symbiosis with a soil bacteria called *Rhizobium*, which is able to transform nitrogen from the air into ammonium, which the plant can assimilate. Plants which are effectively fixing nitrogen can be identified by the appearance of nodules on their roots. Actively fixing nodules have a pinkish interior color. The inputs from BNF and deep soil nitrogen capture provide sufficient N for the subsequent maize crop without requiring N fertilizer additions.

Biological Nitrogen Fixation (BNF) by fallow species in Western Kenya.

Species	Recyclable N 9 month fallow (kg N/ha)	Proportion of N Derived from BNF (%)	Amount of N fixed (kg N/ha)	
			8 month fallow[1]	12-15 month old fallow
Crotalaria grahamiana	150	67-80	150	90-220
Sesbania sesban	60	49-65	70	60-120
Cajanus cajan	110	57-72	110	110-170
Tephrosia vogelii	120	58-73	110	-

1) optimum growth conditions on farmers field

Why mixed species fallows?

Improved single species fallows might fail due to adverse weather conditions (drought, logging) or establishment failure (poor seed quality or lack of proper seed pre-treatment). Some fallow species are less effective in capturing subsoil nutrient or nitrogen fixation than others. The introduction of new species to the area has led also to the build up of new pests (e.g. caterpillar attacks on *Crotalaria grahamiana* are now more often observed). On the other hand recent evidence suggests that the indigenous *Sesbania sesban* together with *Tephrosia vogelii* are hosts for root-knot nematodes (that are nodule like but are not easily rubbed off), which affect also common beans. Hence, it is recommended not to plant beans in the first season after these fallows. Thus increasing the biodiversity of the system by using mixed species fallows is essential to ensure sustainability of the production system.

Advantages of mixed species fallows

Sesbania-Crotalaria mixed fallow

Insurance against fallow fails due to adverse weather conditions (drought, logging), pest attacks or establishment failure. The more resistant species will at least partially compensate for the low yield or failure of the susceptible species.

Multiple use of by products: *Sesbania* fallows produce a large proportion of wood (80% of biomass), which is very much appreciated by farmers, who are deprived of firewood. However, the partitioning of resources into wood leads to a lower amount of foliage returned to the soil and leads to export of fixed nitrogen from the plot (30%). Mixing *Sesbania* with *Crotalaria* ensures both the benefit of wood as well as a large production of foliage biomass.

Improved utilization of available resources: The tall *Sesbania* with an open canopy mixes well with the lower but dense growing *Crotalaria*. This leads to a better light utilization. Mixing the deep-rooted *Sesbania* with *Crotalaria* leads also to a better subsoil mineral nitrogen exploration.

Sesbania-siratro mixed fallow

Maximization of fallow yields: Yields do not necessarily increase under non-stress conditions. However, when siratro was sown under *Sesbania*, *Cajanus*, and *Tephrosia*, larger yields were observed.

Prolonged residual effect: Mixing species of different leaf qualities and decomposition rates may reduce nitrogen losses and extend the time of residual effect.

Reduced pest pressure: Reduced insect attacks have been reported in mixed compared to single species fallows but further investigations and testing by farmers are needed.

Recommended Species Combinations

1. For recycling of deep soil N, high inputs from biological nitrogen fixation and a wood component:
   Sesbania sesban + Crotalaria grahamiana
2. To maximize fallow biomass production or to provide a fodder (siratro, up 2t/ha in 6 months) component:
   Sesbania sesban + Macroptilium atropurpurem
3. For producing a food crop during the fallow period:
   ***Sesbania seban* + groundnut**
   ***Cajanus cajan* + groundnut**
   As *Sesbania* and *Cajanus* have an open canopy during the early establishment a short duration groundnut variety can be planted in between the *Sesbania* rows during the short rains (groundnut yield is about half of pure groundnut stands).

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Using the Local...

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three months) and late-maturing cultivars (e.g., *Kaledades*, harvestable after seven months). This provides a steady supply of sweetpotato roots to meet household food needs for longer period.

Uses

Local people develop indigenous strategies in the utilization of sweetpotato, which influence decisions on cultivar choices. The market makes a similar influence as it creates demand for cultivars with specific uses. In the uplands of northern Luzon, creeping-type cultivars serve the purpose of cover cropping as part of soil conservation efforts. In central Luzon, high-starch *Bureau* and *Superbureau* became dominant cultivars at the time farmers sought to exploit market opportunities created by the establishment of sweetpotato starch factories.

Exchange of Planting Materials

In the Philippines, informal social networks of women are key channels for the diffusion of cultivars through the exchange of plenting materials. Kinship ties and traditional leadership authorities are also key factors in sustaining collective efforts to conserve sweetpotato diversity, such as the establishment of community-managed genebanks.

Fallow Reduction in Highland Shifting Cultivation in Northern Thailand

P. Wangpakapattanawong and D.E. Thomas

Generally, Thais have a perception that shifting cultivation is the only form of farming system practiced by all hill tribes. In fact, different groups of hill tribes practice different types of farming systems. The Karen typically practice a short-cropping-and-long-fallow-period shifting cultivation. Other forms of agricultural systems of the Karen include paddy-rice cultivation and home gardens. Traditionally, the Karen grow both paddy and upland rice. The relative proportion of the two systems varies among the villages, depending on geophysical attributes of each village. However, the Karen prefer to have as much paddy-rice areas as the physical characteristics allow because paddy rice commonly provides better yield than upland varieties, and the paddy fields are normally close to streams (Zinke et al. 1978. Rerkasem and Rerkasem 1994).

The forest-fallow system of shifting cultivation of upland rice and other food plants practiced by the Karen people of Mae Hae Tai village, Chiang Mai, northern Thailand, is changing due to increasing population and a resulting decrease in per capita arable land base. This has resulted in a reduction of the fallow period, which was 10 or more years in the past. The fallow is traditionally believed to act to restore and sustain soil fertility and control weed populations; it may also be important for enhancing upland rice productivity by maintaining soil structure and in other ways. Presently, this system involves 1 year of cropping, followed by 5 years of crop-free fallow. The national Thai government is trying to change shifting cultivation to fixed-field agriculture under the assumption that all forms of shifting cultivation are destructive and are not sustainable. Some ecologists and social scientists oppose the idea using arguments about the ecological and cultural integrity of this traditional farming practice. There has been little empirical research to examine the advantages and disadvantages of the system. One of the main reasons for not having empirical research done about shifting cultivation is that the Thai government fails to recognize it as a legitimate form of agriculture. In addition, the situation is complicated by the land-right issue of whether ethnic minorities do legally possess land ownership titles. Therefore, they cannot prevent outsiders from encroaching upon their lands, resulting in land scarcity.

Ecological studies were conducted to examine the nutritional aspects of the forest-fallow shifting cultivation using field experiments and a chronosequence of fields (Wangpakapattanwong 2001). The study site is located in the Mae Hae Tai Karen village, of the Mae Chaem watershed, located about 160 km southwest of the city of Chiang Mai. The average elevation of the village is 1,000 m asl. The farmers were interviewed about their traditional knowledge of shifting cultivation system management. The yield of the upland rice crop under this system was found to be about 1 t/ha, but is variable within fields, between fields, and between years. An ICRAF-supported socioeconomic survey in the same watershed as Mae Hae Tai found upland rice yield to be 3 t/ha, resulting from shifting cultivation with a longer fallow – e.g., 7-10 years of fallow (Thomas et al., 2002). The soils (0-5 cm) of the shifting cultivation fields of Mae Hae Tai village were rather clayey (about 40% clay) and slightly acid (pH between 5 and 6 in water). Soil bulk density was approximately 1 g/cm^3, with 6.0-6.8% organic matter, and about 0.3% total N. Soil available P was very low (2-3 ppm). The soils were believed to be sufficient for rice production in K, Ca, and Mg, and the ash effect appeared to enhance their availability. When soil properties were measured again after 1 year, changes were not significant, except when the 5-year fallow field was converted to a cropping field by field clearing, burning, and cropping.

Straight from Asia

It was initially hypothesized that soil organic matter, as an indicator of soil fertility, would decline after nutrients were exported in rice grain and after rapid decomposition of organic matter during the cropping period; it would have increased as a result of litter addition from fallow vegetation toward the end of the fallow period.There was no clear trend of SOM or N changes as the fallow aged. The change of SOM in the chronosequence of the shifting cultivation fields was rather small in a crop-fallow rotation of 6 years. When a comparison of SOM in the rice field (6.8%) and in a nearby secondary forest (7.9%) was made, there was insignificant difference. In addition, there was also an insignificant difference of SOM between the rice field (6.8%) and the fallow fields (5.8-6.7%). Therefore, the initial SOM level in the forest might not be that high.

The chronosequence study revealed that during the 5 years of fallow, there were slight increases in SOM and total N (attributed to the addition of litterfall from the fallow species) but a decline in pH, available P, and extractable K, Ca, and Mg. These decreases are attributed to nutrient uptake by the fallow vegetation and a decline in the effect of the burning at the end of the previous rotation. The largest changes in soil conditions took place when the 5-year fallow field was slashed, burned, and cropped. Standing-tree biomass increased gradually during the fallow period. *Chromolaena odorata* dominated the first 2 years of the fallow period, and it accumulated about 7 t/ha of aboveground biomass within 1 year after rice harvest. Fertilizer trials of the regular first-year and the experimental second-year upland rice crop showed that N was the most deficient nutrient thus affecting upland rice productivity. This supports the nutritional role of the fallow.

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Mixed Species...

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4. Other successful combinations: ***Sesbania+ Tephrosia vogelii.***

Other farmers are however, encouraged to test other combination for their sustainability for their particular needs. To ensure optimal use of the fallow the subsequent maize should be fertilized with 50kg P/ha and 50 kg K/ha as most soils of Western Kenya are strongly P deficient and some are K deficient.

Management of mixed species fallows

Optimum management is important for a successful mixed species combination. Particularly the sowing time is crucial as otherwise strong competition from the faster establishing species suppresses the development of the other slower species.
Recommended sowing times are:
Sesbania sesban: at maize planting (due to slow establishment) during the long rains in the maize row (spacing 75 cm). *Sesbania* needs to be scarified by soaking them in warm, but not boiling, water overnight.
Crotalaria grahamiana, Tephrosia vogelii, Cajanus cajan: after second weeding during the long rains in maize row (spacing 75 cm). No seed pre-treatment is required.
Macrotpilium atropurpureum: at second weeding broadcasting. Siratro seeds need to be scarified on sand paper.

Benefits of mixed species fallows

Recommended minimum duration is about 9 months with larger yield benefits obtained for longer duration fallows. The costs of fallow establishment and loss of a maize crop are offset by the increased grain yield after the fallow, reduced labor and potential savings in N fertilizer.

Increase in maize grain yield over yield of continuous maize control following improved fallows in Western Kenya (values in brackets are benefits in 2-4th crop after fallow).

Species	Byproduct	Increase in maize grain yield (t/ha)		Economic benefit[1]
		6-9 month fallow	12-15 month fallow	K/ Sh/ ha/3 seasons
Sesbania + Crotalaria	Wood 4-10 t/ha	1-2 t/ha (0.5-1)	2-5 t/ha (1-2 t/ha)	15000
Sesbania + sitrato	Fodder 1-4 t/ha	1-2 t/ha (0.5-1)	2-5 t/ha (1-2 t/ha)	20000
Sesbania + groundnut	Groundnut 0.2 t/ha	1-2 t/ha (0.5-1)	2-5 t/ha (1-2 t/ha)	23000

1 of a 6-9 month fallow above continuous maize cropping

Coffee... break!

A Case of Improved Fallow

In Nueva Viscaya, Northern Philippines, 5 or 6 years ago, one of the tribal elders invented an effective technique of shortening the usual fallow period of 15 years to just 7 years. This is called Pangomis. In this technique, seedlings of Alnus nepalensis is planted in the field shortly after the first planting of Ipomoea batatas. So, when the fields are ready for fallow the seedlings are already knee-high. In 6- 7 years, they are ready for cutting, thus Ipomoea sp. can be planted again.

-shared by Delbert Rice- Fallownet discussion list

Providing Knowledge Support...

continued from page 1

She was part of a delegation of a " farmer to farmer" sharing session in a nearby community.

Supporting Self Help

An increasing number of upland farmers in Southeast Asia such as Nang Editha are taking advantage of recent technological and institutional innovations to help improve farm practices and overcome hunger and poverty. These innovations are building on two important milestones: the lessons of the earlier green revolution programs and the recent policy reforms towards decentralized natural (forest) resources management.

The International Fund for Agricultural Development (IFAD) and the World Agroforestry Center (ICRAF) are now collaborating to provide "knowledge support" on soil management and agroforesty for representative community initiatives in Southeast Asia. The joint Project is called the Technical and Institutional Innovations Project for the Upland Poor or simply the Innovations Project.

The collaborative knowledge support under the Innovations Project includes documentation of beneficial farmer practices and development and testing of innovations. This is in support of government and non- government programs that directly work with farmers. An example of such government program being supported is the Western Mindanao Community Initiatives Project which helps Nang Editha. There are three of these type of programs in the Philippines, two in Indonesia, two in Laos PDR ,and one each in Cambodia and Vietnam.

Innovations for the upland poor

Commodity price trends plus forestry policy changes are stimulating more intensive agriculture in the IFAD-assisted project areas pointing to the need for more creative soil management interventions. For instance strong Thai market for yellow corn are competing with traditional land use practice of corn–soybean cropping in the district , Battambang , Cambodia. The recent Lao PDR policy to limit the land for slash and burn is encouraging farmers to do more in less land.

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